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Government of Canada Regional Industrial Expansion | **Gouvernement du Canada Expansion industrielle régionale**

FINAL REPORT

MINI-SKIDDER PROJECT

Prepared by

SIAR INCORPORATED

January 1988

FINAL REPORT
MINI SKIDDER PROJECT

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I. INTRODUCTION

SIAR has been asked by the Department of Commerce and Technology of New Brunswick to carry out a study of the market potential for a smaller log transportation machine or "Mini-Skidder". As well as analyzing the possibility of finding a company involved in forestry equipment or related area to set up a manufacturing joint venture with a local company for the development and manufacturing of the new machine in New Brunswick.

The work has been carried out together with a local consulting company, Agfor Ltd. SIAR has been responsible for all international work and Agfor for work in Canada.

The funding for the Mini-Skidder project has been shared by the Government of New Brunswick and the Regional Industrial Expansion Program of the Government of Canada under the Canada/New Brunswick Industrial Development Subsidiary Agreement. If there is a second phase in this project, it will be funded also in part by the local company involved in the manufacturing joint venture.

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II. EXECUTIVE SUMMARY

This report covers a general overview of the skidder market in North America, concentrating on the eastern regions of the US and Canada. The main emphasis of the analysis is towards the understanding of the factors that influence the need for a smaller skidder. There is also a description of potential international markets for a mini-skidder. The main conclusion is that there is a limited need for a smaller machine, but this machine should be available not only as a skidder but also as a forwarder. The market overview is followed by a historical analysis of the skidder industry and of existing skidder manufacturers.

Finally, we give a description of the "new machine", including sales volume projections in the "home market" and international markets. The last section of the report includes a "long list" of companies that could be potential candidates for a manufacturing joint venture in New Brunswick. We have made preliminary contacts with some of the companies on the list, but we have not started any in-depth analysis in regards to strategic and operational fit with a local manufacturer. This will be the first step of the next phase of the project, and it has to be carried out together with the local company. The thirteen companies in the "long list" could be interested in locating manufacturing capacity in New Brunswick.

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III. BACKGROUND

According to the terms of reference for the Mini-Skidder project, the need for a smaller machine has developed in harvesting operation of small woodlots. The approach during our interviews has been to confirm the factors that are stated as influential to harvesting and silvicultural operations on small woodlots:

1. Small operating areas which are often geographically scattered.

2. Relatively small volume of wood can be harvested at a given site.

3. Harvesting is often carried out as part of thinning operations.

4. Minimization of damage to the ground surface and to the residual stand is required in order to obtain access to the property.

5. Capital cost of equipment together with wood value, are significant factors in justifying silvicultural activity.

The combination of these factors and the need for new sources of wood fiber lead to the use of smaller machines to harvest small woodlots which otherwise would not be productive. We have used this as our **first** hypothesis to compare information from all levels of actors within the wood harvesting industry, from wood lot owners to manufacturers of equipment. It is interesting to see that most of the "first generation" skidders available in the market were very similar in size and power to the specifications given by the ACWER group of FERIC. These machine are still being used after 10-15 years, and there is a big demand for renovated "first generation" skidders. The extended lifetime of skidders is maybe one of the main reasons why the big skidder manufacturers are not interested in producing the smaller models. Competition from used machines is strong and margins are low. And most buyers of new equipment are the big contractors that prefer to get larger and "more efficient" machines.

The **second** hypothesis was that the smaller machine the market needs is a skidder, as this was the assumption that the terms of reference and the FERIC article presented. Skidding is also the predominant log transportation system in North America, which is also the home market for the "mini-skidder".

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Our **third** hypothesis has been that the most logical fit for a joint venture with a New Brunswick manufacturer should be a small or medium size company that is interested in having production capacity in Canada. It is also important that the partner is not affected by the cannibalization effort of a mini-skidder on its existing larger models already available on the market.

As the report will show, we have confirmed the first hypothesis, even though some of the factors are less important, at least with a short term perspective. The third hypothesis is true and the second one we have modified after having carried out extensive interviews with dealers and users. The machine we are proposing in this study is a modular line of equipment which includes both a skidder and a forwarder combination. A more detailed analysis of the reasons for the change is included under **Chapter VII** of this report.

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FACTORS AFFECTING THE ESTABLISHED MARKET SIZE FOR "MINI SKIDDERS"

Total Supply of Skidders (Including Used)
Total Timber Demand/Supply Situation
Trends in Harvesting Practices and Techniques
Market Size for "Mini Skidders"
Logging Industry Situation
New Applications (Pioneer Market)
Landowner Preferences
Land Ownership Structure

Figure 1

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IV. MARKET ENVIRONMENT

The character of the North American forestry industry shows substantial variation in different geographic areas. The southeast is noted for its rapid growth softwood and the West Coast for its stands of very large trees. Buyers, be they mills or independent owner operators, purchase equipment to fit their particular woodland needs as well as to integrate with their existing equipment. The comments in this chapter refer only to the market environment in Eastern North America.

Figure 1 summarizes the SIAR picture of the factors that affect the established market size for "mini-skidders". By established market, we mean existing techniques and practices for logging, without considering new applications, which we see as an important new factor that will have a big influence on the long term size of the "mini-skidder" market.

In this chapter we analyze and describe in more detail each of the seven factors shown on **Figure 1**. It has been the result of the more that one hundred interviews we have carried out with woodlot owners, forestry specialists, forestry equipment manufacturers and distributors, logging contractors and others involved and/or affected by logging activities. **Appendix 1** includes a summary of all the interviews carried out during the months of October, November and December*. Some preliminary contacts had been taken for the preparation of SIAR's proposal and during the period of time before the project started in September. Several of the people on the list have thus been contacted more than once.

The majority of interviews regarding the market environment have been made with people in Eastern Canada and USA, as this will be the home market for the "new machine". Based on this picture of environmental conditions, we have looked at other areas in the world with similar conditions and have drawn a picture of international market opportunities in the form of a world map (see **Appendix 2**). The most important international markets are described in **Chapter VII**.

* **Appendix 1** also includes samples of questionnaires used for interviews with woodlot owners and equipment distributors.

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TOTAL TIMBER DEMAND/SUPPLY

Overall slow increase in consumption/production

Slight differentiated increases in prices per end use and geographic area

Possible local shortages in the near future

US import regulations will highly affect timber export volumes from Canada

Figure 2

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The Total Timber Demand/Supply

We have analyzed the total demand/supply situation for North America and have found that there is a slow increase in consumption/production of timber (see graph of volumes in the US in **Appendix 4**). This has a direct effect on the need for new forestry equipment and also on prices for timber. Changes in production volumes vary by region and as **Appendix 3** shows, in the five New England States there was even a small decrease in production of both hardwoods and softwoods in 1985, which has turned around for 1986 and 1987. The small increase in harvesting volume combined with differences in demand for end product markets have lead to differentiated increases in prices per end use and geographic area. We think that the price differentiation will increase as the dollar exchange rate decreases and demand in export oriented end user markets will increase. The price for the raw material in those areas where the export oriented industries are located will thus be higher than areas with industries that concentrate on production for local end user markets.

The direct implication of the slight overall increase in demand for timber and especially the regional imbalances will push for harvesting in marginal areas that can not be carried out with the existing large skidders. There will also be an increased need for thinning and the exploitation of non-utilized woods belonging to small woodlot owners. The proposed "mini-skidder" will fit very well the void left by the existing supply of new large skidders and the older smaller skidders that will gradually be pulled out of production due to high maintenance costs. The new Free Trade Agreement between the US and Canada will increase the gap between timber consumption and production in the US (see **Appendix 4**) due to higher volumes of imports from Canada. The need to harvest marginal forests in Canada will thus be higher than in the US and the market for a smaller transportation machine will develop first in the Canadian forests that produce for US markets.

Finally, there is a natural differentiation between regions in North America due to type of terrain, tree diameter and density of trees. **Appendix 5** shows a summary of these differences comparing different areas in Canada and in the US. It shows very clearly that the assumption we started with in this project regarding geographical market limitations for a smaller machine to the North American East Cost is valid. There could also be opportunities in other areas such as the interior of British Columbia, Western Ontario and the Northern Great Lakes in the US. In **Chapter VII** we deal in more detail with potential markets for the "New Machine".

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TOTAL SUPPLY OF SKIDDERS

Major North American manufacturers left small skidder market due to shift in preference for high volume productivity machines

Only one small wheeled skidder is still produced in North America (Dunham)

Large stock of used small and medium sized machines is available in a wide price range

Figure 3

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Total Supply of Skidders

The supply of new skidders in the North American market has decreased to less than half of the yearly shipments during the record year of 1975. The graph in **Appendix 6** shows the development of skidder factory shipments in North America starting with the first skidders manufactured during the end of the 60's. (The historical development of the skidder industry is described in **Chapter V**). The yearly shipments have been divided evenly between Canada and the US.

The two yearly peaks in shipments at nearly 7,000 in 1969 and more than 8,000 in 1975, represent machine sizes comparable to what we define as a "mini-skidder" in this report. Most of these smaller machines are still in operation and have been renovated and sold several times. The main skidder manufacturers decided to discontinue the smaller models and concentrate on more powerful and bigger skidders that are better adapted to industrial clearcut operations. This trend is reflected in the decline in unit shipments after 1975. A graphic based on sales figures would show a less steep drop during the 70's. Besides being better adapted to the needs of those that buy new forestry equipment, i.e. large contractors and forest owners, the larger skidders allow for a higher profit margin for the manufacturers. Smaller contractors and land owners usually buy smaller used machines. **Appendix 7** gives an overview of skidders available in North America. This overview shows a description of the smallest model and the range of larger skidders for each manufacturer.

Appendix 7 includes also a description of the "mini-skidder" proposed for manufacturing in New Brunswick and a Kubota farm tractor which is being used by some farmers for forestry applications. The only skidder comparable in size and price with the proposed one is the Dunham 760, which differs in that it is non-articulated, 2-wheel drive and not suitable for cold climates. Another alternative to the proposed "mini-skidder" is Treefarmer's model C4D even though it is slightly bigger, more powerful and more expensive.

Since 1982 there has been a slight increase in the total factory shipments for skidders and the trend seems to be positive even for the future. There will be a window of opportunity during the 90's when many of the old machines will have to be scraped after more than 20 years in operation. The demand for smaller new machines will increase during this period, and it is possible that several of the skidder manufacturers will be interested in this market segment.

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TRENDS IN HARVESTING PRACTICES

Increase in thinning due to younger stands, education and regulations

More wood processing at the stump

Increased demand for more professional and less brutal harvesting

Pre-commercial thinning will increase in the future

Figure 4

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Trends in Harvesting Practices and Techniques

Trends in Harvesting Practices

Harvesting practices may be categorized into two basic types — industrial and private woodlots. With respect to industrial practices, large clearcuts in excess of 100 hectares is the case, in general. On private woodlots, the practice of "liquidation" is still a common phenomenon in Eastern North America. In this case, the landowners strike a deal (i.e. agree on a stumpage value) with a contractor to harvest an entire parcel of land. In some locations, thinning is becoming popular, primarily due to regulations, economic incentives and education, respectively. Where owner education and economic incentives for silvicultural practices are effective, there is a general trend towards clearcutting smaller areas.

On industrial lands, the general trend is to reduce the labor requirement "at the stump" and to shift processing to areas where the wood can be concentrated. There is also a movement to mechanize as many functions as possible in an effort to reduce wood costs and to deal with labor shortages. On industrial lands, the mechanization has resulted in the introduction of feller bunchers, larger cable and grapple skidders and mechanical delimbers. This change has led to a shift form tree length systems to full tree systems.

Due to the "economies of scale" and high initial capital investment of full-tree systems, the private land contractor has not adopted this method. Currently, the private land contractor is doing some or all processing at the stump.

With respect to operating practices on private land, it should be noted that there is increasing demand for more professional and "less brutal" harvesting. This demand is slowly increasing and represents a very low percentage of the harvested volume in most areas. But this factor will be one of the driving forces in the development of demand for a "mini-skidder", as small wood lot owners ask the contractor to use a smaller machine as a condition for harvesting.

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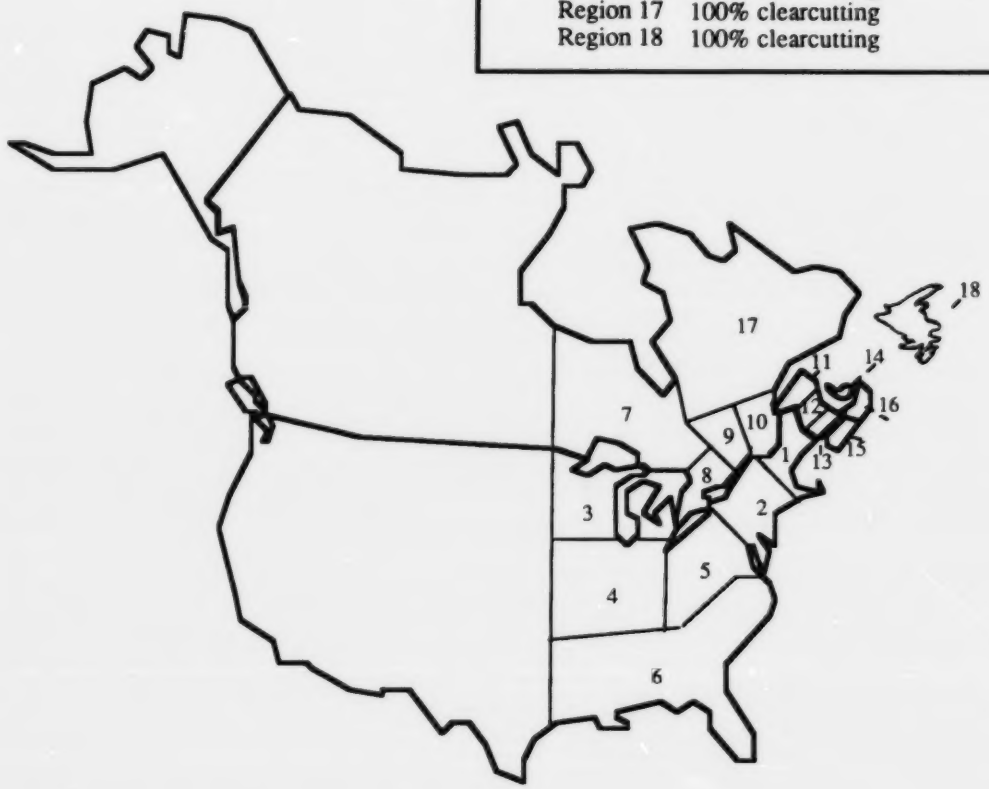
HARVESTING METHOD MAP

CANADA

Region 7	100% clearcutting
Region 8	30% clearcutting, 70% thinning
Region 9	50% clearcutting, 50% thinning
Region 10	50% clearcutting, 50% thinning
Region 11	50% clearcutting, 50% thinning
Region 12	100% clearcutting
Region 13	100% clearcutting
Region 14	100% clearcutting
Region 15	60% clearcutting, 40% thinning
Region 16	100% clearcutting
Region 17	100% clearcutting
Region 18	100% clearcutting



USA

Region 1	80% clearcutting, 20% thinning
Region 2	30% clearcutting, 70% thinning
Region 3	50% clearcutting, 50% thinning
Region 4	40% clearcutting, 60% thinning
Region 5	50% clearcutting, 50% thinning
Region 6	60% clearcutting, 40% thinning

Figure 5

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Harvesting Method Map

We have developed a map to show the differences in harvesting methods between regions in Eastern North America. There is a difference between the figures for the US and Canada, as the US statistics refer to all forest harvesting operations and those for Canada only to harvesting in private woodlots. But even with this difference in statistics, there is a clear dominance of clearcutting in Canada compared with combined clearcutting and thinning in the US. Some of the regions in Canada deserve additional comments:

- Region 8 has a preponderance of Red Pine and hardwood (of varying values). Ownership is generally private with a somewhat discriminating landowners. These facts along with government legislation of harvesting practices, have led to thinning as being an increasingly important harvesting method.

- Regions 9, 10 and 11 are receiving relatively high prices for their wood. Owner education and the presence of forestry cooperatives have also influenced the harvesting practices of these regions, such that thinning is more common than in Atlantic Canada. The high pulpwood prices have prevented a trend towards sawlogs from developing. The shortwood system, including 4' wood, still prevails in regions 10 and 11.

- Region 14 has farm woodlots that are typically less than 10 hectares. Clearcuts are small and full tree chipping for the local energy-wood market is common.

- Region 15 has historically been a sawmilling area with selective logging for pine and red spruce sawlogs. Economic incentives for thinning and the activities of regional forestry group ventures have allowed thinning practices to prevail.

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TRENDS IN HARVESTING TECHNIQUES

Forwarding/skidding ratio will remain constant in most regions, as there will be no important changes in harvesting short wood or tree length

Shift towards forwarding in some regions where pulpwood operations dominate

Shift from cable skidding to grapple skidding

Higher mechanization of felling, bunching and delimbing

Figure 6

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Trends in Harvesting Techniques

With respect to the wood volume harvested from private lands, the ratio of wood skidded versus that which is forwarded should remain constant in most regions. Any new volume would come from woodlots whose owners are not currently harvesting. This new volume would tend to increase the forwarder share. There will also be a shift towards forwarding in regions where new volume is required and/or thinning increases. If private land contractors identify and invest in systems to mechanize felling and processing then, depending on the location of that processing, there could be an increase in shortwood forwarding.

Other techniques that will change in harvesting operations are the shift from cable skidding to grapple skidding, as a direct consequence of an increase in the number of feller bunchers. There will be a quick development towards higher mechanization in forest operations including felling, bunching and delimbing. North America will approach the level of mechanization in Scandinavia, but it will take many years before all Scandinavian techniques can be applied in the US and Canada.

In **Appendix 9** we have included a map that shows the regional breakdown of methods for off-road transport. In this map there is the same difference in statistics between the US and Canada as in the Harvesting Method Map (**Figure 5**). We assume that the share of skidding versus forwarding will remain relatively constant, with skidding dominating most regions, except for the Great Lakes region in the US and parts of the Maritime Provinces in Canada.

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LOGGING INDUSTRY SITUATION

Low profitability due to faster increase in capital and labor costs than in wood prices

Overcapacity and hidden capacity due to cyclicality

Still low barriers to entry for hidden capacity

Increased volume orientation

Figure 7

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Logging Industry Situation

The current problem facing contractors is a low profitability due to faster increases in capital and labour costs than in wood prices. Industrial contractors have been forced to mechanize felling and processing. Investment into these new systems has been recognized by forestry companies and has resulted in a general increase in the piece rates associated with felling and processing. However, in an effort to maintain their cost curve, forestry companies have not recognized the increased demands placed on the off-road transport (skidding) phase by these new systems. As a result, moving wood from the stump to the road has become an unprofitable venture. Current low profitability is a major limiting factor for the investment in new technology for off-road transportation of wood.

With the private land contractor, felling and processing is still performed manually. Increased costs in labour along with a widespread shortage of skilled labour and relatively low increases in the price of wood has forced some contractors to accept a "less-than-reasonable" return on their equipment or has forced them out of the business.

For the present volume of wood harvested there is an overcapacity of "wood-moving" equipment. Most of this is due to the unexpected long life of the skidder and the fact that new units are more productive than the units they replace. Almost all of the skidders sold in Eastern Canada since 1970 are still operating in some capacity. If the price of wood were to increase dramatically this overcapacity would be used up and the hidden capacity would begin to surface. That is to say, there is currently a hidden capacity for the production of wood. The barriers to entry into this hidden capacity are low and a relatively low investment is required to get into the "wood-producing" business. To justify the purchase of new or nearly new equipment requires a guaranteed volume for wood delivery per contractor. Some industrial contractors can obtain such a guarantee. Private land contractors, in most cases, cannot. As a result, they are forced to buy and operate used equipment.

The trend in logging contractor's shipments in the US (**Appendix 9**) shows that the harvesting volume has increased steadily since the 70's, except for a decline in -81 and -82. The graph is in dollars and the price of timber has not had big fluctuations so the increase refers also to harvested volume. Bigger and more efficient machines have increased productivity and supply of timber, which has had a stabilizing effect on timber prices.

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LANDOWNER PREFERENCES

Increased aesthetic concerns

Higher economic pressure on the owners to harvest

Extent of harvesting depends on profile and economics of owner

Higher level of education in forestry management

Figure 8

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Landowner Preferences

We can partly confirm one of the starting points for this study, namely the increased aesthetic concerns among small landowners. This is especially true around the densely populated areas such as Vermont, New Hampshire, Southern Maine, Eastern New York, Ontario and Quebec. The reason for this is the shift in ownership structure. Farmers and part time farmers are decreasing slowly in number while retired people, businessmen, professionals and wage earners are growing. The growing groups tend to value forests higher for recreation purposes than do the farmers.

The increasing subdivisions of land around urban areas especially in central New England causes legislators to stimulate or pressure landowners to harvest. The most common form is imposing a penalty tax if the landowner does not file and follow a forest management plan. We expect to see more and stricter legislation in this area in the future. Pressuring the more harvest-adverse groups to harvest, demand for smaller log transport machines will grow slowly.

The propensity for a woodlot owner to harvest depends on a number of variables as outlined in **Appendix 10**. The groups most concerned about the aesthetic aspects of thinning appears to be the retired people and the business/professionals who often own land for recreation purposes. These two groups, together with the speculators are the fastest growing groups especially in Southern Ontario and central New England. The two farmer groups have been decreasing in number the last six years.

Another trend we can identify which will affect the market potential for a mini-skidder is the increasing level of education in forestry management. In Canada the movement is towards more cooperatives, which not only provide support in forestry education and operation, but could also be the pioneers in the use of smaller log-transport equipment. In the US, small woodlot owners associations are growing rapidly in size especially in New Hampshire, Vermont and Maine. These organizations strive to increase both commercial and pre-commercial thinning.

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LAND OWNERSHIP STRUCTURE

Subdivision of land in certain regions mostly around urban areas

Owners shift from farmers to wage earners, speculators and retired people

Figure 9

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Land Ownership Structure

Many of the current landowners who harvest wood use the liquidation approach and cash-in on their woodlots. However, there is a trending away from this in some regions. Ontario, Quebec, Southern Maine, Vermont and in areas of specialty markets or metro areas show this trend. This is a "slow-trend" and stems from a change in landownership profiles. In the aforementioned regions there has been a slow shift from the "farmer woodlot owner" to woodlot owners who are white or blue collar workers, speculators or retired individuals (see **Appendix 10**). Some of these woodlot owners don't have to harvest, but would harvest when stumpage values increase. Some of these owners place aesthetic, rather than monetary, values on their woodlots - although there are costs associated with these values as well. The advent of forestry cooperatives and group ventures have to some extent created a "melting pot" for woodlot owners reducing the differences between owners to conduct forestry activities on their properties. To some extent (for example Southern Ontario and Quebec) landownership structure has been influenced by legislation protecting forestry and agricultural lands. In many other regions, farm land has reverted back to forest land.

The landowner profile summary in **Appendix 10** defines the profiles of different types of forest owners and also the level of interest these may have in buying forestry equipment as well as the requirements they have in a small log-transport machine. The changes in land ownership structure described above have not increased the probability of a landowner buying a skidder, on the contrary the "new" owners of forest have less interest and need for harvesting and do not buy machines that can not be used for other applications than just skidding. Most of these owners, including the farmer or part time farmer, would get a specialized contractor to harvest the forest. Some of our interviews show that these contractors would have a better opportunity of getting harvesting contracts from small private woodlot owners if they could provide a "mini skidder" for log-transport.

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PIONEER MARKET

Main driving force

- More educated contractors seeing opportunities
- Municipalities
- Government agencies
- Wood producer coops
- Universities

Pioneer Dealer

- The factory outlet
- Does not sell a major forestry line
- Capacity to service
- Serving rural clientele

Figure 10

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Pioneer Market

The early stages of market development of the "new machine" will have to be supported by a Pioneer Market (PM). This includes new dealers, buyers and applications. No matter how good the concept and the machine there will be a time period when the "real" market will have to acquaint itself with the new product. The PM will also serve as a barometer for the "real" market, success in the PM is essential if the product is to survive. Then, if the machine is proven reliable and a viable alternative, a product awareness stage will have been achieved and an appropriate strategy will be developed. The PM will have to be defined geographically, or targeted to specific segments in order to maximize success and concentrate experience. The new machine will have to quickly establish a reputation for after-sales service, parts availability and profitability in the PM area.

The pioneer buyers would typically be composed of:

1. The more educated contractors seeing opportunities for accessing new wood volumes. The pioneer contractor will be a "risk-taker". This will be the buyer segment with the biggest potential beyond the PM phase.

2. Municipalities who may be interested in conducting forestry activities in environmentally sensitive areas i.e. watersheds. This is essentially a low growth segment beyond the PM phase.

3. Government agencies primarily forestry and/or woodlot owner oriented who may purchase the new machine for testing or demonstration purposes.

4. Wood producer coops who may purchase for forestry activities or demonstration purposes. These groups may also play a role in providing incentives for contractors to purchase the equipment. Such an incentive might be the sale of a guaranteed wood volume. This is a limited growth segment beyond the PM phase.

5. Universities may constitute a small market share and would purchase the equipment for testing or demonstration purposes.

6. Vocational training schools for forestry would buy the new machine for testing training and demonstration purposes.

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Essentially contractors and coops would be the target group for long term marketing. The participation of the other groups mentioned would be critical to the survival of the machine and manufacturing facility in the PM phase. We expect that the PM phase for the "new machine" will be three years, and we recommend that it concentrates on the home market area for the new manufacturing facility in New Brunswick: the Atlantic Provinces and northern New England.

We have introduced the "mini skidder" concept in the interviews carried out with landowners and contractors, but it has been difficult to quantify the potential interest for a new machine. Without having a detailed specification or prototype, it is nearly impossible to give accurate figures of sales volumes. During the PM phase, it will be much easier to carry out detailed market analysis by market segments. The projections shown in **Chapter VII (Figure 14)** are based on the fact that there will be a need to cover the demand for smaller used skidders when the "first generation" used skidders have to be scraped. And as we have shown in the different sections of this chapter, the trend is towards a slow increase in demand for "mini-skidders" due to:

- Increase in demand for timber, which puts pressure on harvesting marginal areas, such as small private woodlots.
- Increased thinning and more professional harvesting.
- Changes in land ownership structure towards smaller lots.
- Small landowners have increased aesthetic concerns.
- Improvement of logging contractors education, some young "pioneer contractors" have been identified.

All these factors lead to the use of a smaller machine for log-transport. Today there are enough used small skidders to cover this demand, but there is a limit to how long these machines can continue working at a reasonable operating cost level. There will have to be some kind of incentive to push "pioneer contractors" to buy a "mini skidder" that is three or four times more expensive than a used machine of similar size. The incentive will develop during the PM phase especially from the wood lot owner demand for a small machine based on the factors stated above.

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The Pioneer Dealer

During the initial PM phase, it would be desirable to administer sales, parts and service from a factory outlet. This should not present a problem, as the initial market should be within "striking-distance" of the factory. A dealer network could then be established according to the geographic trends in machine sales.

To some extent, starting with a "factory-outlet" dealership would allow the marketing management to better understand the requirements necessary in a dealer for this product. It would allow the opportunity to build a "dealer profile" for selecting the right type of dealer for marketing beyond the initial PM phase.

Although not fully defined, the "pioneer dealer" beyond the factory outlet stage, should:

1. Not be selling a major forestry line (no conflicts)
2. Have the ability to service the units
3. Have the capacity to serve a rural clientele.

An agricultural equipment dealer may prove to come closest to meeting these conditions.

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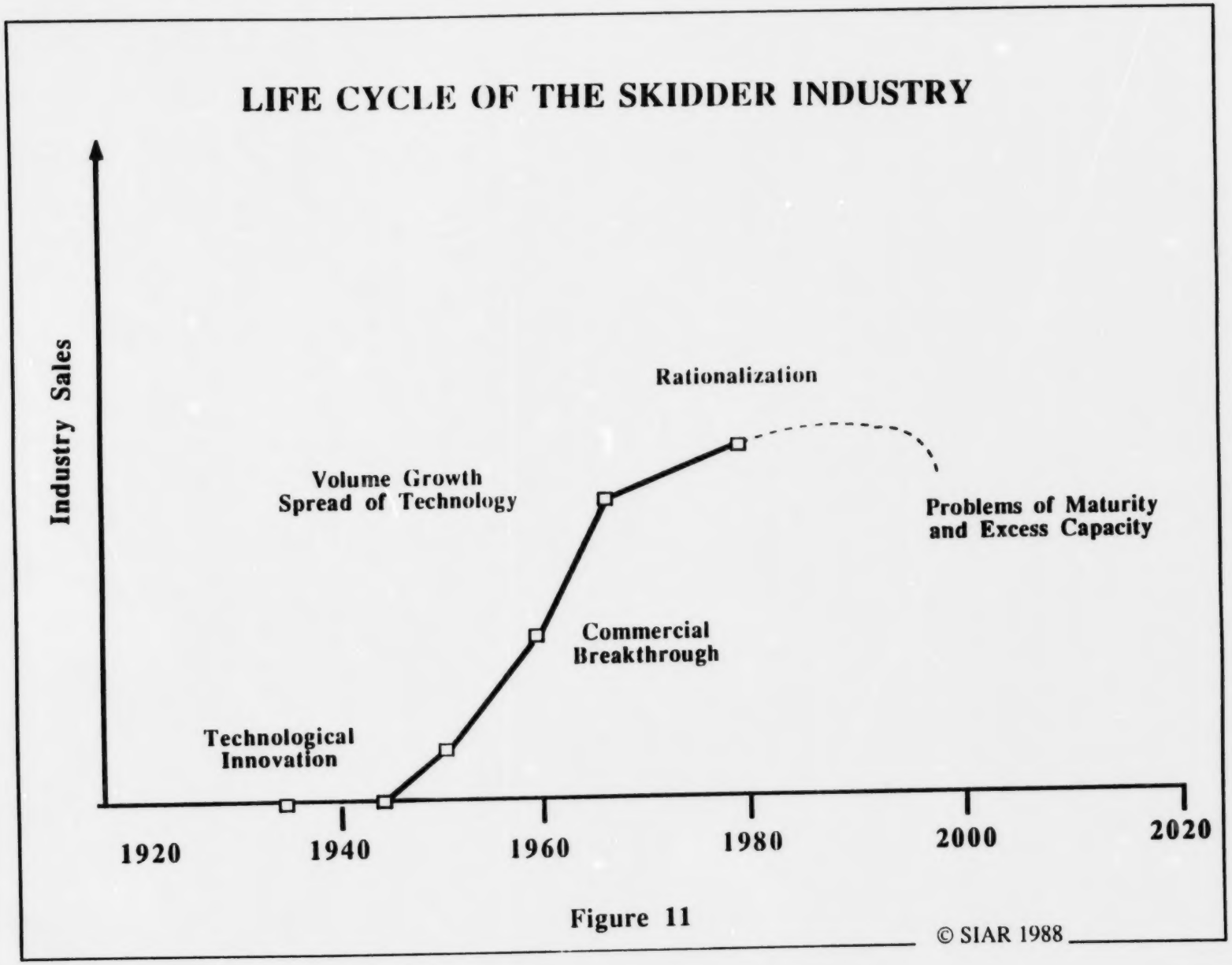
LIFE CYCLE OF THE SKIDDER INDUSTRY
Industry Sales
Rationalization
Volume Growth
Spread of Technology
Problems of Maturity
and Excess Capacity
Commercial
Breakthrough
Technological
Innovation
1920
1940
1960
1980
2000
2020
Figure 11
© SIAR 1988

V. THE SKIDDER INDUSTRY

As most other industries, the skidder industry has developed through a five-stage life cycle which is qualitatively illustrated on the adjacent graph (**Figure 11**). The graph in **Appendix 11** shows an approximate evolution of the total volume of operating skidders in North America.

Prior to the introduction of the first skidders in the **1940's**, the forestry function remained relatively unmechanized. Mechanized methods were used in situations where the woodland environment was suitable for the use of standard agricultural or industrial equipment. Efforts to improve efficiency and productivity in the lumber industry had so far been focused on the mill itself and not on the forest.

In the **1950's**, mechanization developed around two products, skidders and loaders. Loaders, however, were initially adapted from loaders used in other markets particularly construction. Therefore, the history of forest mechanization up to the mid-1960's is largely that of the skidder.

Progress on the development of the first articulated wheeled skidder was being made simultaneously at a number of different sites in the late 1950's. The first major breakthrough came when Garrett, a Washington engineer, constructed an articulated wheeled skidder from individually purchased components. Canadian Car Company, a subsidiary of Hawker Siddely, decided to build it. This product, named Treefarmer, was the forerunner of the modern articulated wheeled skidder.

Timberjack (then Timberland) realized the potential of this product and developed a new, improved skidder, branded "Timberjack".

Early sales of articulated skidders were concentrated on the West Coast of the U.S. and Eastern Canada. Garrett sold the manufacturing rights to Canadian Car for the East Coast and kept the West Coast for himself. Canadian Car with its Treefarmer, faced increased competition from Timberjack in Quebec, Ontario and the Atlantic Provinces.

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In 1959, Pettibone, a manufacturer of construction and agricultural equipment, entered the market. Pettibone's skidder had mechanical difficulties and the company never became a major player. Franklin, however, a small Virginia based manufacturer who originally distributed Pettibone skidders, was considerably more successful. Franklin had low overhead and freight costs, and because he was from the South, he appealed to local Southern buyers.

Therefore, the early market development proceeded separately in each of the major North American forestry regions. Only in Eastern Canada was there direct competition between two suppliers. The biggest problem for the suppliers was educating the market. Loggers had been using horses up till then and were slow to accept the new system of forestry operation.

The commercial breakthrough stage in the early **1960's** was characterized by a wave of new entries into the skidder market. Total skidder production increased with 50% from year to year, topping 6700 units in 1968. At this time, the first signs of a maturing industry surfaced. Following rationalization in production and a saturation of the market, the industry had excess capacity. Due to the longevity of the machines, replacement demand did not suffice to keep production up.

During the **1970's**, five of the eleven North American producers exited the industry and the total capacity became more balanced with the demand which increased to a top in 1975 of more then 8,000 units.

The manufacturing of skidders is primarily an assembly operation. Fixed capital intensity is quite low, requiring only $1 million of net plant and equipment to produce $10 million of sales. Six purchased components (engine, two axles, transmission, four tires and rims, transfer case, and winch) alone account for two thirds of the total manufacturing cost. Marketing, physical distribution and technical costs in this industry are small compared to the costs of manufacture.

Geographically, the Canadian skidder industry is concentrated to Southeastern Ontario, while in the U.S. the plants are scattered in the Midwest and South East (see **Appendix 12**).

The three main categories of skidder end-users are woodlot owners, small contractors and large contractor companies.

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Woodlot owners is the most price sensitive segment. Buyers in this group are often parttime loggers who harvest when pulp or sawmills need extra wood on short notice. This "reserve capacity" prefers used equipment due to the low operating rates, and the average machine size is much smaller than for other groups.

Small contractors typically have only one or two skidders and twice as many loggers operating chainsaws. If more than one skidder is employed in a team, they often complement each other in size. Independent owner-operators are more "emotional" in the buying process. Reference is often made to a local "opinion leader". As a group, small contractors are less aware of the latest developments in the industry as are the large mills which rely more on personal contact and word of mouth than on routine analysis.

The medium and large size contractors are usually fully mechanized using feller-bunchers, delimbers, slashers and sometimes their own trucks. This category is less price sensitive, prefers the larger skidders, and buys mostly new machines. The category also includes major pulp and paper producers who operate large fleets and therefore purchase a greater number of units. As a buyer group, it can be characterized as "specifications oriented" using monographs for weighing dozens of attributes against job requirements such as tree size, terrain, wage rates, price, maintenance cost and downtime.

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SKIDDER MANUFACTURERS

Company	Caterpillar	John Deere	VME Group	Treefarmer	Franklin	Dunham	Timberjack
Sales (USD M)	$6,725	$6,011	$809	$17 (e)	$21	$5	N/A
Employees	53,616	43,011	7,310	200	275	70	N/A
Net Income(Loss)	$198	$31	($1)	N/A	N/A	N/A	N/A
Forest Equipment	Skidders Track-Type Tractors for Logging, Wheeled Loaders	Feller-Bunchers, Skidders, Loaders, Bulldozers	Skidders Loaders	Skidders, Forwarders	Skidders, Forwarders, Feller-Bunchers, Loaders	Skidders, Loaders	Skidders, Forwarders
Skidders							
- Models	3 models	8 models	4 models	5 models	5 models	2 models	5 models
- Rated Power hp	110-175 hp	90-167 hp	122-204 hp	80-210 hp	92-166 hp	97 hp	100-201 hp
- Price, smallest model	$85,000	$63,500	$67,000	$50,500	$56,000	$35,000	$63,500
Orientation	Diversified - Construction - Agriculture - Forestry - Industrial				Specialists		

Figure 12

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VI. SKIDDER MANUFACTURERS

The main skidder manufacturers in North America are included in **Figure 12**. There is a big difference between the companies and they can be divided into two main groups:

- **Diversified companies** like Caterpillar and John Deere, which manufacture forestry equipment as one of several types of industrial equipment. The forestry equipment division usually manufactures other equipment besides skidders. Most of these companies have started by producing construction equipment which during the 60's and 70's was adapted to forestry applications.

- **Specialist companies** concentrate on forestry equipment only, and are thus much smaller than the diversified companies. They do manufacture other types of forest equipment besides skidders.

These seven companies manufacture most of the more than 4,000 skidders supplied to the North American market every year. There are very few imports, except for agricultural tractors that are used for forest applications, i.e. Kubota and Pasquali. The figure in **Appendix 13** shows a graphic analysis of the skidder buyers/end-users with the right top quadrant (skidder's with more than 60 Hp and priced about $60,000) covering medium and large machines acquired by contractors and the left bottom quadrant (less than 60 Hp and $60,000) covering small machines/tractors acquired by woodlot owners. The proposed mini-skidder will be located in the center of the graph towards the small contractor segment. The main competition to the mini-skiddder will be the used skidders which attract buyers from both the small contractor and the woodlot owners segments.

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MARKET SPECIFICATION - "NEW MACHINE"

- Skidder forwarder product line

- Skidder: cost less than $60,000 can

- Forwarder: cost less than $70,000 can
  - Using a common front half (power source)
  - Full by-directional operations capabilities
  - Hydraulic based
  - Farm tractor based or manufactured depending on partner
  - Locally well known components
  - 60 HP minimum

OPTIONAL: CAT. 2 3PT hitch and PTO

Figure 13

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VII. THE "NEW MACHINE"

The Market Specification for the "new machine" presented in **Figure 13**, includes the additions and differences from the specifications provided in the terms of reference for this project. After carrying out more than one hundred interviews with different parties involved in the logging and forest equipment industries, we have concluded that a new machine for log-transport has to include both a skidder and a forwarder version.

The interviews have shown that the market for a small log transport machine is too limited in Eastern North America to develop a "new machine" that is only covering skidding applications. Even though forwarding is not predominant in this area for log transport in small wood lots and thinning operations in general (where the "new machine" will be applied), it is the most efficient off-road transport method for these applications. It will take some time before contractors are convinced about the advantages of forwarding, and this is the reason why we recommend a skidder/forwarder product line instead of only looking at a "mini skidder". The customer will have the opportunity of choosing the skidder or the forwarder, depending on the prevailing method in his operation. But he will have the flexibility of shifting to the other version at a lower cost than buying a new machine by exchanging the rear half and keeping the front power source. The change will only be done by the factory or specialized dealers, not the contractor. We call the combination of a skidder and a forwarder, with a common front half, a skidder/forwarder product line. (See sketch in **Appendix 14**). We have found that there is a similar trend in Europe to develop a smaller forwarder for use in private small woodlots and in thinning operations. This fact will make it much easier to find a partner in Europe that could be interested in developing and manufacturing a machine which can also be exported to his home market from a low cost manufacturing facility in Canada.

Interviews with manufacturers and dealers indicate that it will be nearly impossible to manufacture (with the given specifications) the skidder version under CAD $60,000 and the forwarder version under CAD $70,000. This price increase limits the potential market size and makes the introduction more difficult, but it is better to introduce a new-machine with a technological advantage (such as hydraulic base and full-by-directional operation capabilities) and a higher price compared to existing used machines. The used small skidders (at price levels from $15,000-$45,000) will always be the main competition to the skidder version of the new mini-machine. The number of used machines will decline through the nineties and will thus provide a window of opportunity for new mini-skidders.

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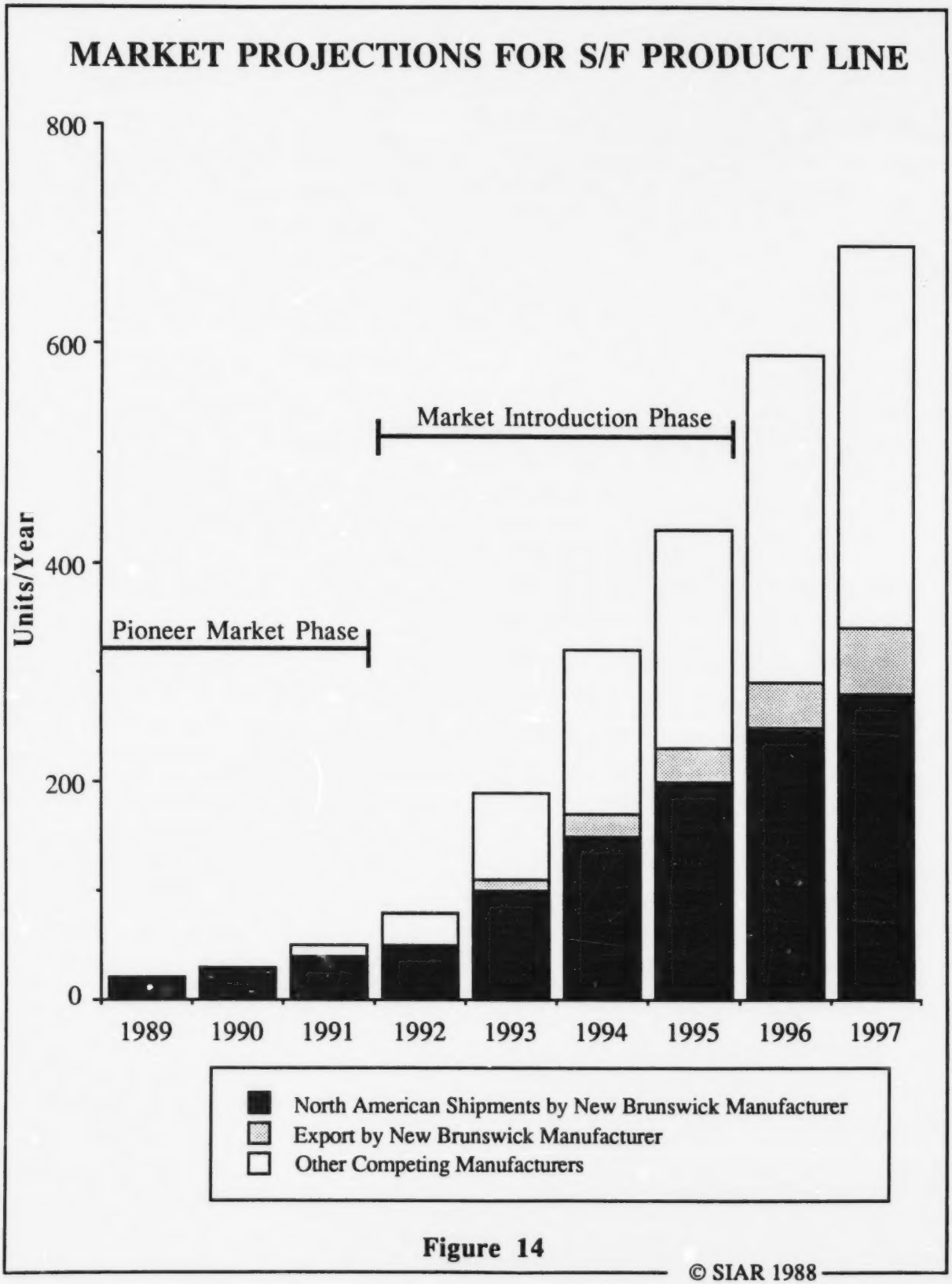

Figure 14

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Figure 14 shows the market projections for the skidder/forwarder product line. It is based on several assumptions:

- Sales of new skidders and forwarders in North America will increase form 6,000 units in 1989 to 7,000 units in 1997. There will be some variations around this trend depending on the condition of the economy, but the average number of units sold during the ten year period will be 6,500 per year.

- The small machines will not exceed 10% of the total market for new skidders and forwarders. This limit corresponds to a portion of the existing used small machine market. In our projections this limit will be reached after ten years (1997).

- If the new product line is successful, there will be other companies offering the same size of machine, maybe already during the pioneer market phase.

- The New Brunswick manufacturer will not be able to maintain a dominant position in this segment and already after five to six years market share will decline under 50%.

- Exports from New Brunswick outside of North America will not start until after five years and will not exceed 20% of total units produced.

- It will take 12 to 18 months to develop and manufacture the first prototype. Market projections could shift one or more years if negotiations and prototype developments are delayed beyond mid 1989.

- The Pioneer Market phase (see **Chapter IV**) will take three years form the production of the first prototype.

- After the Pioneer Market phase there will be a period of at least four years of market introduction which includes the development of a dealer network in North America and agents in other countries. If the partner already has access to available commercial infrastructure this period could be much shorter and the position of the New Brunswick joint venture after ten years would be much stronger than shown in **Figure 14**.

- The goals of the second phase (implementation) will be to develop more accurate market projections based on the final design, costs and related prices.

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We have developed a graph showing the relative positions for all the small skidders available in the North American market today and compare this with the proposed mini-skidder version (see **Appendix 15**). This shows that there is a big gap between the smallest skidders in the market used by contractors and the articulated farm tractors used by private woodlot owners. (The size of the circles in **Appendix 15** are proportional to each company's unit sales volume.) The position of the proposed skidder version between skidders and articulated tractors indicates that it would be an advantage to find a partner that has technical experience in one of these types of machines or in both.

Appendix 16 shows a product/customer matrix for skidders indicating preferences within customer groups for different sizes of machines. This shows that the customer group with the highest interest for a small skidder/mini-skidder are the small contractors, the group that should be targeted first during the Pioneer Market Phase. The other two groups that will look at buying a small skidder are the large contractors and large landowners, mainly to complement the range of machines, so that they can harvest marginal forest areas or perform thinning operations. The small land owner will not be interested in the mini-skidder versions until they are available at a lower price level in the used market, five to ten years after the introduction of the first machines.

There are many factors that are important for achieving a successful market introduction of a new machine. In **Appendix 17** we present the five most important for the specific introduction of new forestry equipment like the s/f product line. To be able to manufacture a machine that can be sold at a reasonable price level is crucial, and any small increases in price may destroy the market opportunity, at least as long as there are many cheaper used units available.

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LONG LIST OF POTENTIAL PARTNERS

BRIMONT	France
DUNHAM	USA
FRANKLIN	USA
GREMO	Denmark
HOLDER	Germany
KUBOTA	Japan
NORCAR	Finland
PASQUALI	Italy
ROTTNE	Sweden
TERMIT	France
TEXFORM	Spain
TREEFARMER	Canada/USA
VALMET	Finland

Figure 15

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VIII. PARTNER SEARCH

Based on the findings that there is a limited market opportunity for a smaller log-transport machine in Eastern North America (and possibly also in other international markets with similar conditions and needs) combined with the fact that there is no existing manufacturer of forest equipment in New Brunswick, it has been necessary to look for potential joint venture partners to set up a local manufacturing facility. The long list in **Figure 15** includes all the companies worldwide that could be interested in providing technology and/or market knowledge in exchange for a participation in a manufacturing joint venture located near the main market for the skidder/forwarder product line described in **Chapter VII**.

The long list of potential partners has been set up in alphabetical order because we have not done any in-depth analysis of the order of priority or interest that these companies may have in a joint venture. One important group has been eliminated from the list of candidates, these are the diversified companies in **Appendix 7**, those that manufacture the existing medium size and large skidders. We have interviewed some of them and confirmed the statement made in the Terms of Reference. There are different reasons for this, but their explanation is mainly that the potential sales volume for small machines is not large enough and the introduction of a mini-skidder would cannibalize sales of their existing small and medium size models.

The companies in the long list could be divided into four groups with different company specialties and reasons to participate in a joint venture in New Brunswick as follows:

a. <u>American skidder specialists (Dunham, Franklin and Treefarmer)</u>
They all have the skidder technology and partly the distribution network and they could be interested in starting a new manufacturing venture in Eastern Canada.

b. <u>European forwarder specialists (Gremo, Norcar, Rottne, Texform and Valmet)</u>.
The companies have the forwarder technology, which can be adapted to the proposed combination forwarder/skidder. But the most important incentive for them would be to find a partner that also can assemble or manufacture their existing large forwarders to sell in the North American market. Some of them have made some in-roads in forestry equipment sales in the US or Canada but they do not have established dealer networks. They will have to develop the distribution together with the local partner in New

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Brunswick. Valmet has an advantage in the group, as they are also involved in manufacturing agricultural tractors.

c. Foreign manufacturers of articulated tractors (Holder, Kubota and Pasquali)
It is possible that a smaller skidder/forwarder will have to build upon articulated tractor technology to be able to achieve size/cost advantages in a smaller machine. In that case these three companies have already established limited sales for both agricultural and small forestry applications, which increases their interests for a local manufacturing joint venture that can also manage existing articulated tractor models. The exchange rate advantage for manufacturing in North America, compared to Europe or Japan, provides an important factor to attract them to New Brunswick.

d. French forestry equipment manufacturers (Brimont, Termit)
These are two medium size companies that manufacture both skidders and forwarders, mainly for the French market. Besides the advantages described for the previous three groups, the two companies could build a stronger joint venture based on the close relations between New Brunswick and France.

The second phase of this project will include a deeper analysis of each one of these companies. Based on the strengths and weaknesses of the local partner, we would prepare a short list of potential partners (three to five companies) in order of priority. The final step would be to contact each one of the short list companies and start preliminary negotiations for a manufacturing joint venture in New Brunswick.

In regards to export market opportunities outside of North America and based on expert interviews, we have found that the most feasible markets will be in Europe, mainly France and Spain. There could also be a possibility to export some units to developing countries through projects financed by the Canadian International Development Agency. Countries like China, Chile and Peru have forests with conditions similar to those in Eastern North America. The problem with developing countries is that they do not have the capacity to finance new forestry equipment, at least not as long as they have access to low cost manual methods. Some Scandinavian and Japanese manufacturers of forestry equipment are exporting to Australia and New Zealand, but due to high transportation and market development costs, we do not see this area as a potential export market for the New Brunswick joint venture (at least not during the first ten years of operation).

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IX. CONCLUSIONS

The most important conclusions is that we have found a limited interest for a smaller log transport machine in Eastern North America to start with. And in other areas such as Europe, South America and possibly New Zealand and Australia. at a later stage. The size of the segment will not exceed 10% of the total combined skidder/forwarder shipments in North America, which provides enough volume to attract two to three small manufacturers. Hopefully none of the big players will find it worthwhile to enter the small machine segment, at least not during the first years.

The driving forces described in the Terms of Reference as the main reasons to develop a new smaller machine are there, but not as strong as expected. Maybe the introduction of a smaller machine on the market will reinforce such arguments as minimization of damage to the ground surface and combination of thinning with harvesting for small woodlots.

The two main reasons to develop a new smaller machine are:

- Fill the gap that will appear when older renovated small skidders can not operate due to age and high maintenance costs.

- Need to harvest marginal private wood lots as demand for timber increases , mostly those that would not be harvested with existing equipment.

There are enough reasons for a forestry equipment manufacturer to set up a manufacturing joint venture in Canada. We expect to find the best candidate and help to implement the idea of a manufacturing joint venture in New Brunswick during the second phase of this project.

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FINAL REPORT
MINI SKIDDER PROJECT

APPENDICES

Appendix 1: Summary of Interviews and Questionnaires

Appendix 2: Geographical Markets for a Mini-Skidder/Forwarder

Appendix 3: Production of Hardwoods and Softwoods by State

Appendix 4: Total US Timber Volumes

Appendix 5: Regional Characteristics of Forests and Logging

Appendix 6: Skidder Factory Shipments in North America

Appendix 7: Overview of Skidder Supply

Appendix 8: Off-Road Transport Method Map

Appendix 9: Logging Contractor's Shipments in the US

Appendix 10: Profile of Small Landowner

Appendix 11: Total Volume of Operating Units in North America

Appendix 12: Manufacturing Locations of Wheeled Skidders

Appendix 13: Skidder End-User Segments

Appendix 14: Sketch of "New Machine"

Appendix 15: Relative Position of Small Skidders

Appendix 16: Customer Preferences

Appendix 17: Key Factors for a Successful Market Entry

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SUMMARY OF INTERVIEWS

LANDOWNERS AND WOODLOT OWNER GROUPS	Canada	28
	US	3
	Europe	1
CONTRACTORS	Canada	13
	US	8
EXPERTS	Canada	13
	US,	13
	Europe & South America	6
DEALERS	Canada	2
	US	25
MANUFACTURERS	Canada	5
	US,	5
	Europe, Asia	8

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QUESTIONS TO WOODLOT OWNERS

- Identify wood lot owner forest activities:

  - Number of acres of woodland
  - Do you farm? Acres/crop
  - Volume of wood produced over last five years
  - Method of harvest
  - Level of satisfaction with method
  - Contractors used

- Confirm assumption

  - Degree of harvesting/thinning
  - Environmental and aesthetic concerns
  - Concerns over methods of harvesting

In addition, business **FREEHOLD LANDOWNERS** will be asked to respond to each of the above mentioned topics as well as those listed below.

- Number of employees (direct and contract)
- Other activities (associated and not associated to forestry)
- Area of woodland operated (freehold/other)
- New or used equipment purchases (by contractor and reason)

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QUESTIONS TO CONTRACTORS

- General issues:

  - Location and age
  - Forestry activities in %
  - Types of equipment used for each activity
  - Length of operating season
  - Direct involvement in other enterprises
  - Products and product trends
  - Description of clients
  - Trends in client base
  - Type and size of harvests (and the trends)
  - Preferences of clients
  - Predisposition to operating methods

- Equipment related issues:

  - Rate suitability of current equipment
  - Rate suitability for the anticipated work in the next five years
  - New or used purchase — why?
  - Indicate how equipment could be more useful/profitable
  - Determine opportunities (even limited) for a smaller piece of equipment.
  - Identify that type of equipment — advantages

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QUESTIONS FOR FOREST EQUIPMENT DEALERS

- What is the most common method of transporting logs, (skidding or forwarding) in your geographic area? Pros and cons of the two methods.
- Is any of the equipment used for thinning operations?
- Which method is most suitable for thinning operations in small woodlots and in large woodlots?
- Describe customer base (% landowners, small contractors, industry)
- Exclusive brand dealer? What brands do you sell? Any used equipment?
- What future trends do you see in terms of types and sizes of machines for transportation of logs?
- Do you see a demand for a small skidder or forwarder? Where? From whom?
- How many skidders and how many forwarders do you typically sell in one year?

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QUESTIONS TO PREVIOUS MANUFACTURERS OF MINI-SKIDDERS

- Reasons for involvement in manufacturing a mini-skidder?
- Factors in production and marketing considered to be essential for successful sales?
- Value of sales in units?
- How was sales and service organization set up?
- Technical requirements?
- Why discontinue production?
- Are conditions and demand different today?
- Costs for development of prototype and for starting up production?

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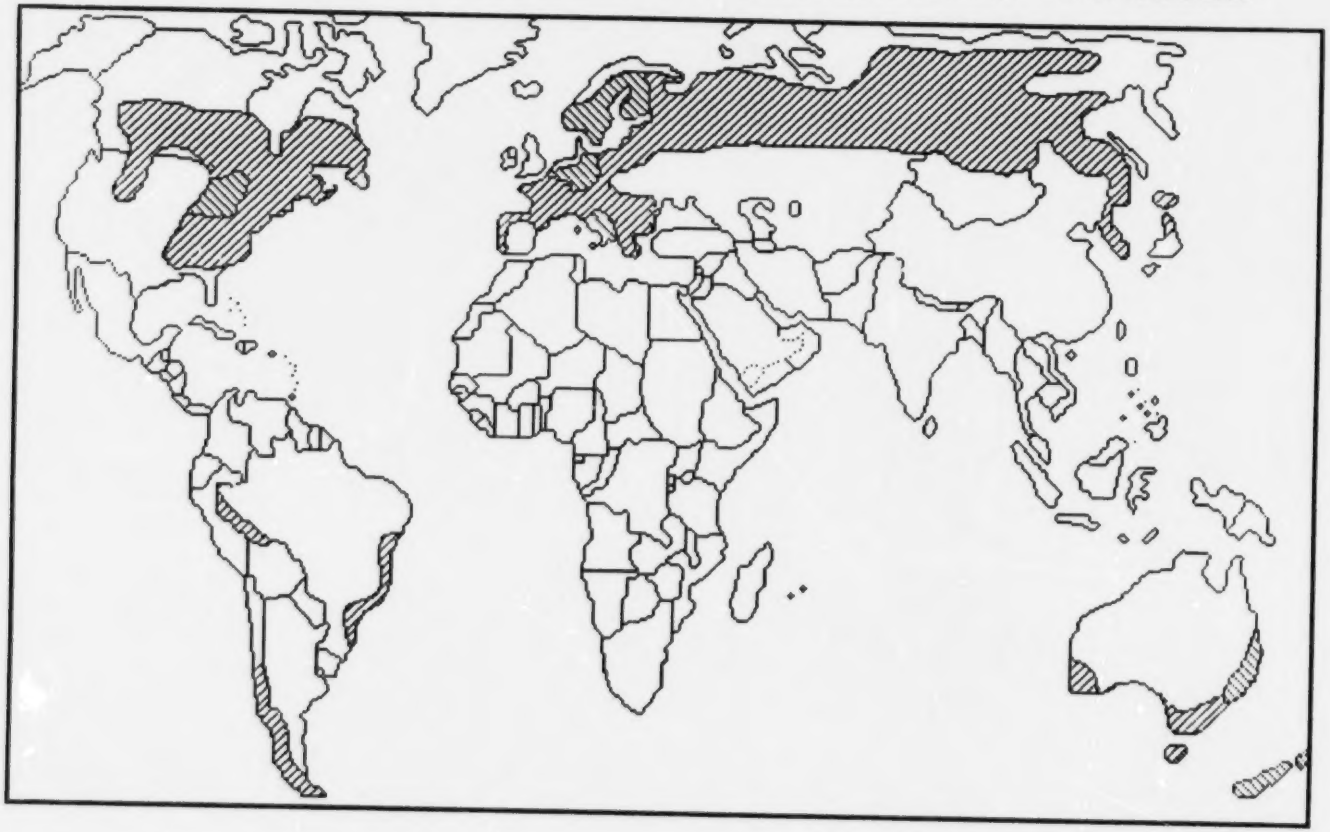
GEOGRAPHICAL MARKETS FOR A MINI-SKIDDER/FORWARDER



Skidders (>50%) dominate and average tree diameters < 15"

Forwarding (>50%)

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Appendix 2

PRODUCTION OF HARDWOODS AND SOFTWOODS BY STATE

(millions of board feet)

STATE	TOTAL			SOFT WOODS			HARD WOOD		
	1985	1984	1983	1985	1984	1983	1985	1984	1983
United States	36,314	37,065	34,553	30,282	30,801	28,926	6,032	6,264	5,627
Maine	743	772	886	636	664	774	107	108	142
Massachusetts	71	90	94	37	40	44	34	50	50
New Hampshire	148	131	127	118	106	102	30	25	25
New York	290	335	357	64	82	81	226	253	276
Vermont	102	93	81	56	56	45	46	37	36
Total 5 States	1,354	1,421	1,545	911	948	1,016	443	473	529
% of total US	3.70	3.80	4.50	3.00	3.00	3.50	7.30	7.60	9.40

Source: An analysis of the Timber Situation in the US, USDA

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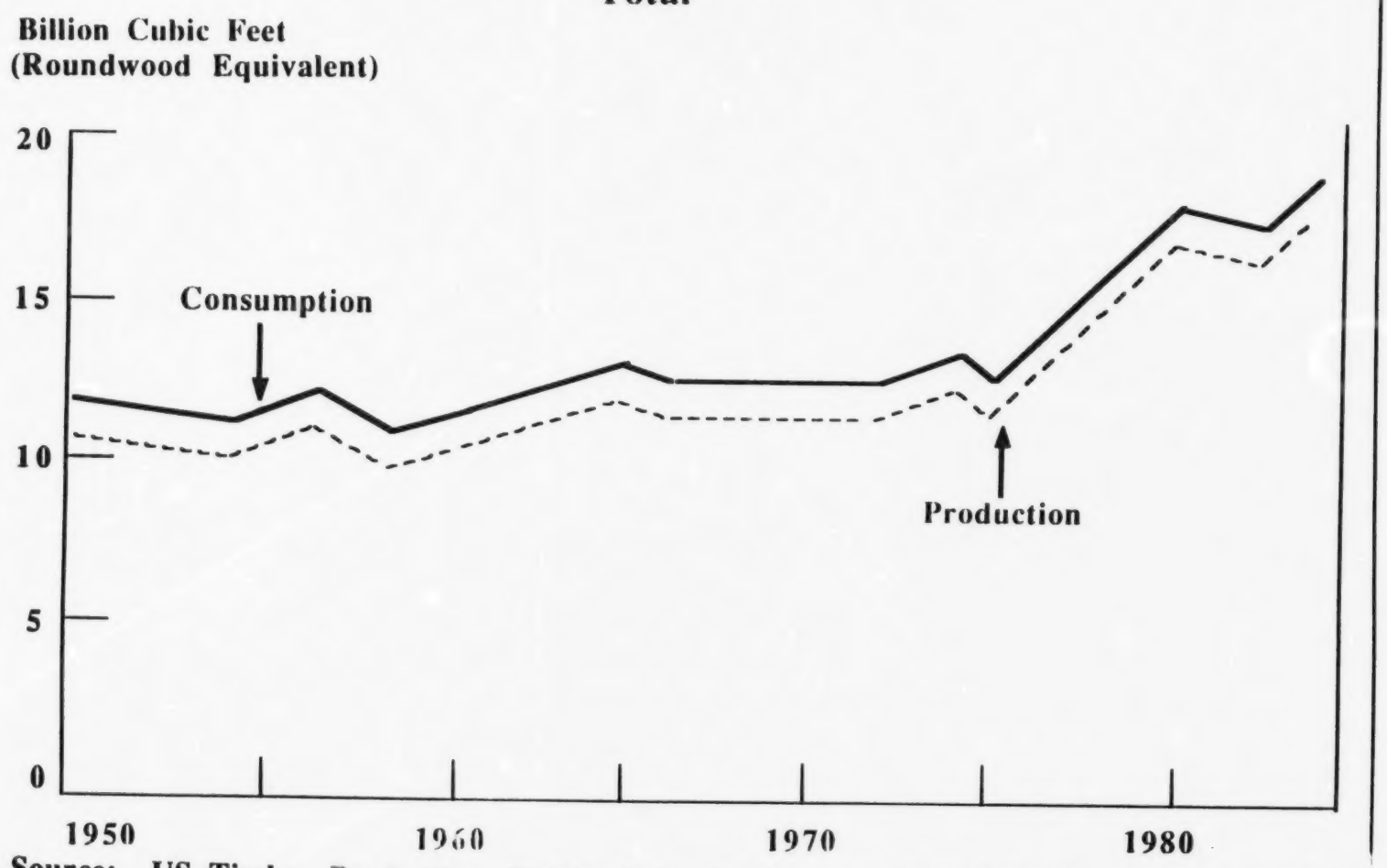
TOTAL US TIMBER VOLUMES

Total



Source: US Timber Production, Trade, Consumption and Price Statistics 1950-85, USDA

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Appendix 4

REGIONAL CHARACTERISTICS OF FORESTS AND LOGGING

ITEM	B.C. Interior Prince George	B.C. Coast Vancouver Island	Northern Ontario	LAC St. Jean Quebec	Bathurst New Brunswick	Northwest USA	Northeast USA	Southeast USA
Woodlands								
Predominant wood species	Spruce/Pine Douglas Fir	Hemlock/ Cedar/	Spruce/Jack Pine	Spruce/Fir	Spruce/Fir	Hemlock/ Douglas Fir	Spruce/Fir	Loblolly Pine
Type of terrain	Rolling	Rolling to steep and	Flat, dry & swampy	Swamp & flat	Rolling	Flat to steep & rocky	Flat & rolling	Flat to rolling
Density trees per acre	30-110	100-300	200-300	270-300	200-300	50-150	200-250	50-250
Average diameter Breast height	12"	22"	8"	7"	7"	20"	10"	8"
Average growth cycle in years	80-100	50-90	95-100	60-80	50-75	50-80	65-75	25-35
Harvesting Methods & Equipment								
Predominant logging method	Tree length	Bucked log	Tree length	Tree length	Short wood	Tree length	Tree length	SW 50% TL 50%
Average tree length cut	80'	100'	35'	35'	35'	120'	40'	45'
Number of days/year operating (cut and haul)	180-220	130-220	240-250	200-210	120-220	180-240	220-240	200-240
Yield								
Cunits per acre	15-20	60-150	12-14	14-17	13-20	60-90	15-17	10-25

Source: Peat Marwick and Partners

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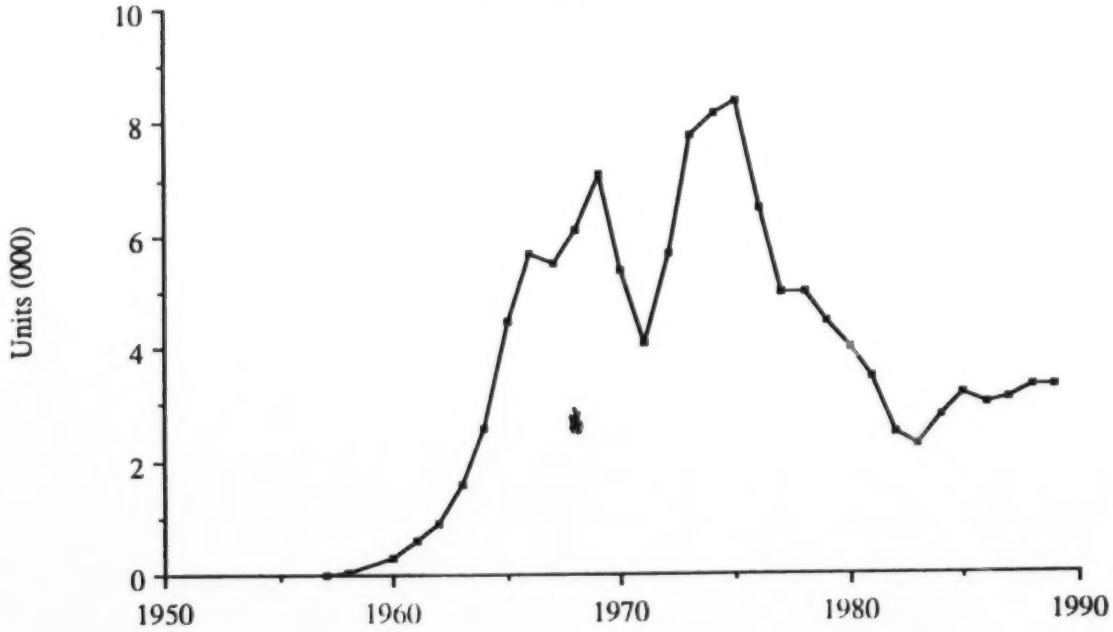
SKIDDER FACTORY SHIPMENTS IN NORTH AMERICA



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OVERVIEW OF SKIDDER SUPPLY

	Kubota	Proposed	Treefarmer	John Deere	Franklin	Dunham	Timberjack	Caterpillar	VME Ranger
Smallest Model	L2850		C4D	440 D	105	760	230A	508	665D
HP (Gross)	34	60	80	90	92	97	100	110	122
Weight (lbs)	2,900	10,000	12,500	14,250	14,920	7,800	15,500	17,500	16,280
Ground Clearance (in)	15	19	23	20	18	13	24	20	24
Height (in)	62	102	107	112	110	94	104	113	116
Width (in)	57	83	107	93	100	83	110	106	104
Length (in)	124	173	211	223	219	170	225	210	220
Price (CAD)	$14,500	$60,000	$67,000	$85,500	$75,000	$47,000	$85,500	$90,000	$89,000
Origin	Japan	New Brunswick	Rexdale, Ont Talladega, AL	Moline, IL	Franklin,VA	Minden, LA	Woodstock, Ont	Peoria, IL	Cleveland,OH
Total Skidder Line			C4D, C5D, C6D, C7D, C7D, C7T, C8C	440D, 540D 548D, 640D 648D/7413 648D/7423 740A 740A/7427	105, 105 105, 142 170	760	230A, 240A 350A/380A 450A, 520 550B	508, 518 528	665D,666D 667D,668D
Note	Garden Tractor					Non-articulated 2-wheel drive			

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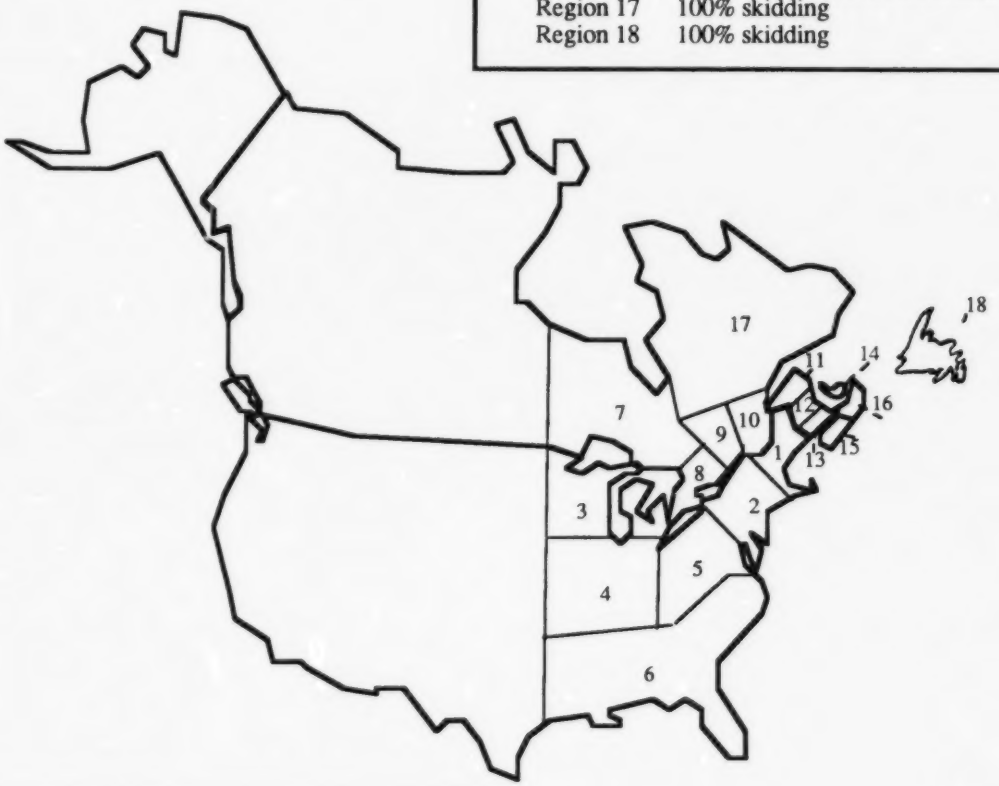
OFF-ROAD TRANSPORT METHOD MAP

CANADA

Region 7	100% skidding,
Region 8	50% skidding, 50% forwarding
Region 9	100% skidding
Region 10	100% skidding
Region 11	20% skidding, 80% forwarding
Region 12	30% skidding, 70% forwarding
Region 13	60% skidding, 40% forwarding
Region 14	100% forwarding
Region 15	60% skidding, 40% forwarding
Region 16	10% skidding, 90% forwarding
Region 17	100% skidding
Region 18	100% skidding



USA

Region 1	95% skidding, 5% forwarding
Region 2	90% skidding, 10% forwarding
Region 3	30% skidding, 70% forwarding
Region 4	80% skidding, 20% forwarding
Region 5	90% skidding, 10% forwarding
Region 6	75% skidding, 25% forwarding

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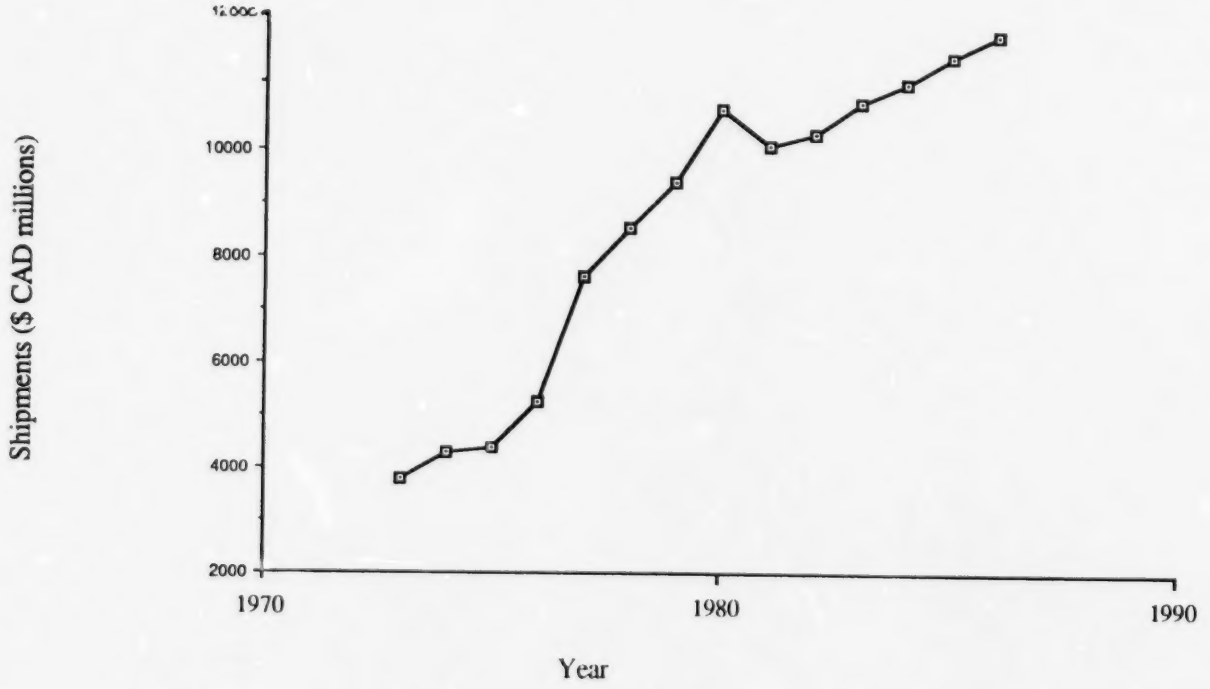
LOGGING CONTRACTOR'S SHIPMENTS

IN THE UNITED STATES



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Appendix 9

PROFILE OF SMALL LANDOWNER

Potential Customer	Profile	Level of Interest in Buying Forestry Equipment	Requirements in a New Small Logging Machine
Farmer	Primary activity is farming Woodlot is usually not an important part of land and is underutilized. Low interest in managing it.	Could afford himself or through coop to invest. A specific investment in forestry equipment only with a very strong timber market.	Machine suitable to be used for different purposes in farming and logging activities
Part Time Farmer	Farming is not an important part of income-tend to value forestry labor higher than farming-very low interest to harvest the lot	Cannot afford to invest unless subsidized. The coop option to ownership is possible.	Small and versatile machine Low priced ($10,000-20,000)
Business/ Professional	Owns usually small wood-lots for basically recreation purposes (weekends, vacations, etc)-favorable to harvest	No economic reason to invest.	Small and versatile machine with low service needs; garden variety
Wage Earner	As business/professional but less financially strong - weak motivation to harvest	Can afford a small investment, but uses contractors or coops mainly.	
Retired	Owns the land either for investment or recreation purposes. Motivation to harvest is quite variable	Financial position varies Willingness to harvest much depends on lot size. Uses small and older technology.	Small and versatile machine with low service needs, as a farm tractor
Speculators or Other	Owns the land for financial purposes-interest in harvest depends on short term economic objectives. Uses contractors extensively.	Low interest	

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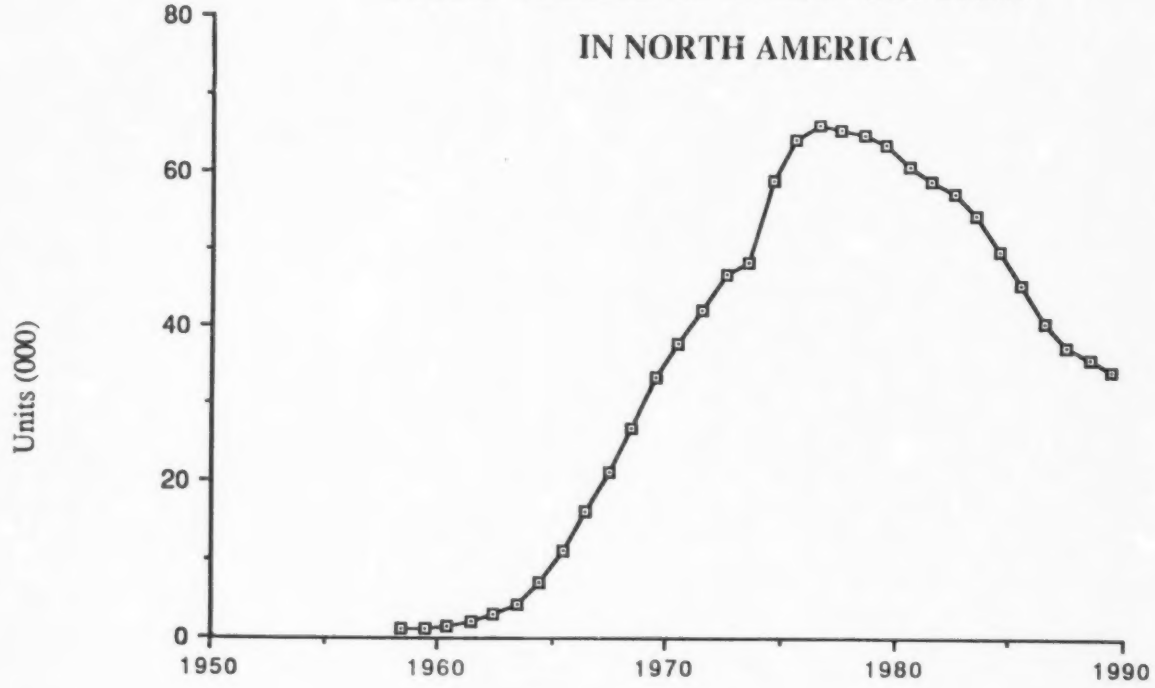
TOTAL VOLUME OF OPERATING UNITS IN NORTH AMERICA



(Assuming an average life of 11 years)

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Appendix 11

MANUFACTURING LOCATIONS OF WHEELED SKIDDERS

1. Caterpillar
2. VME Ranger
3. Deere
4. Timberjack
5. Treefarmer
6. Franklin
7. Dunham

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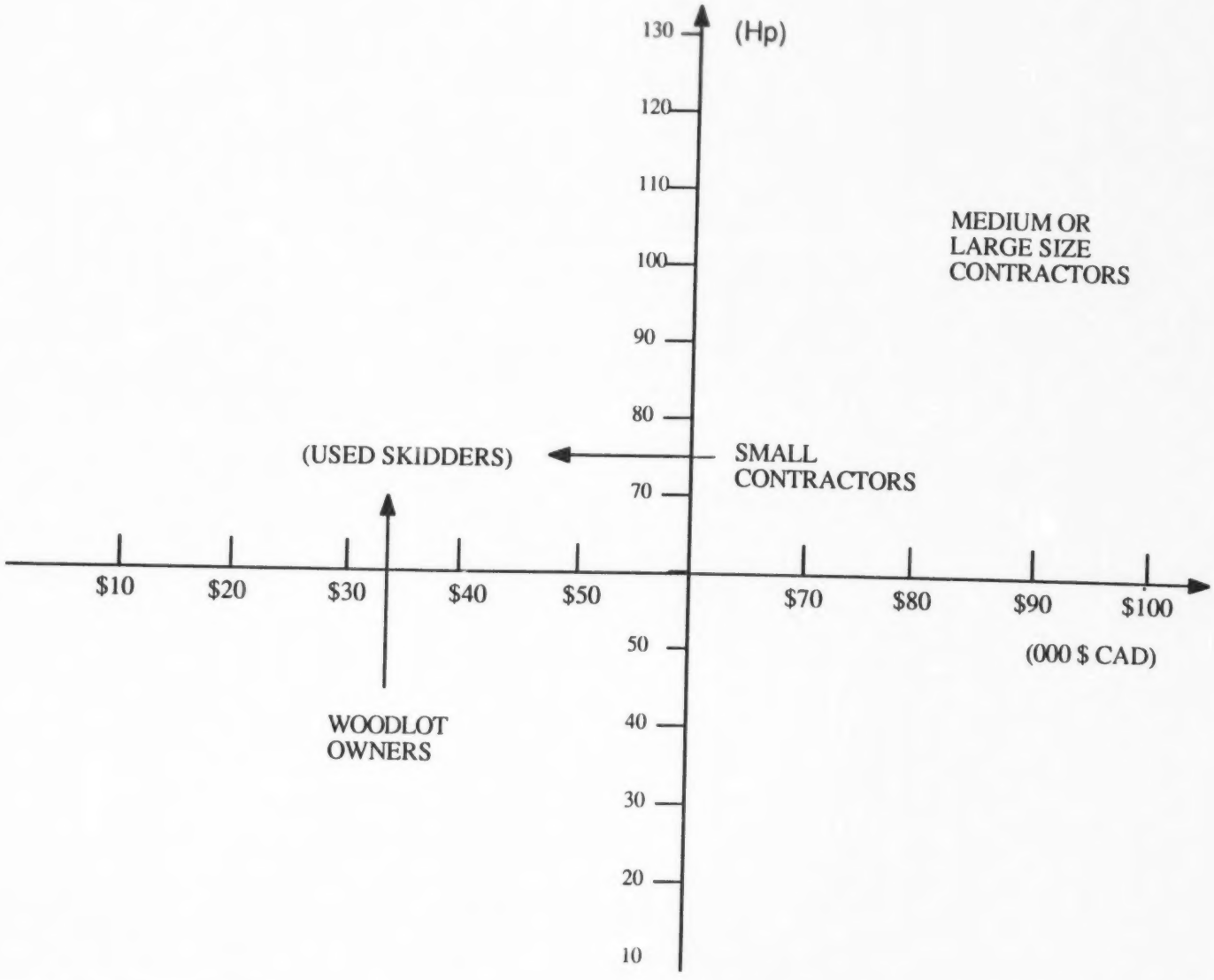
SKIDDER END-USER SEGMENTS



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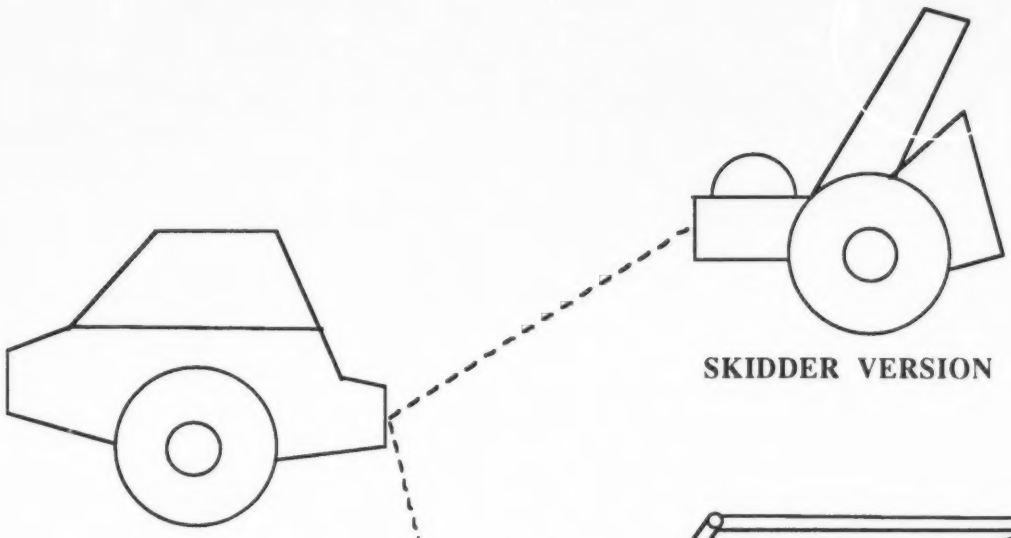
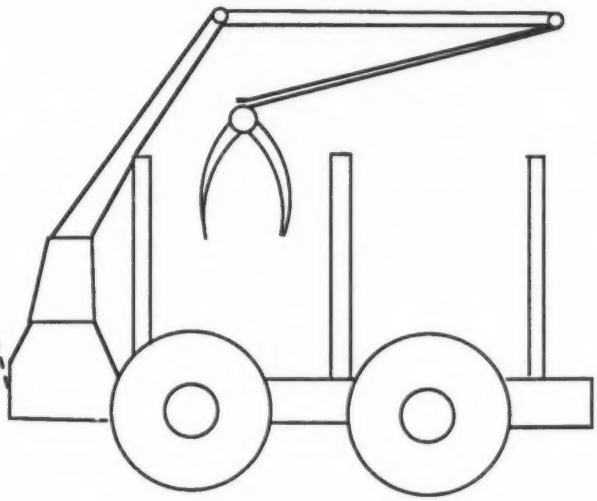
SKETCH OF "NEW MACHIINE"

SKIDDER/FORWARDER PRODUCT LINE



SKIDDER VERSION

COMMON FRONT HALF
(POWER SOURCE)



FORWARDER VERSION

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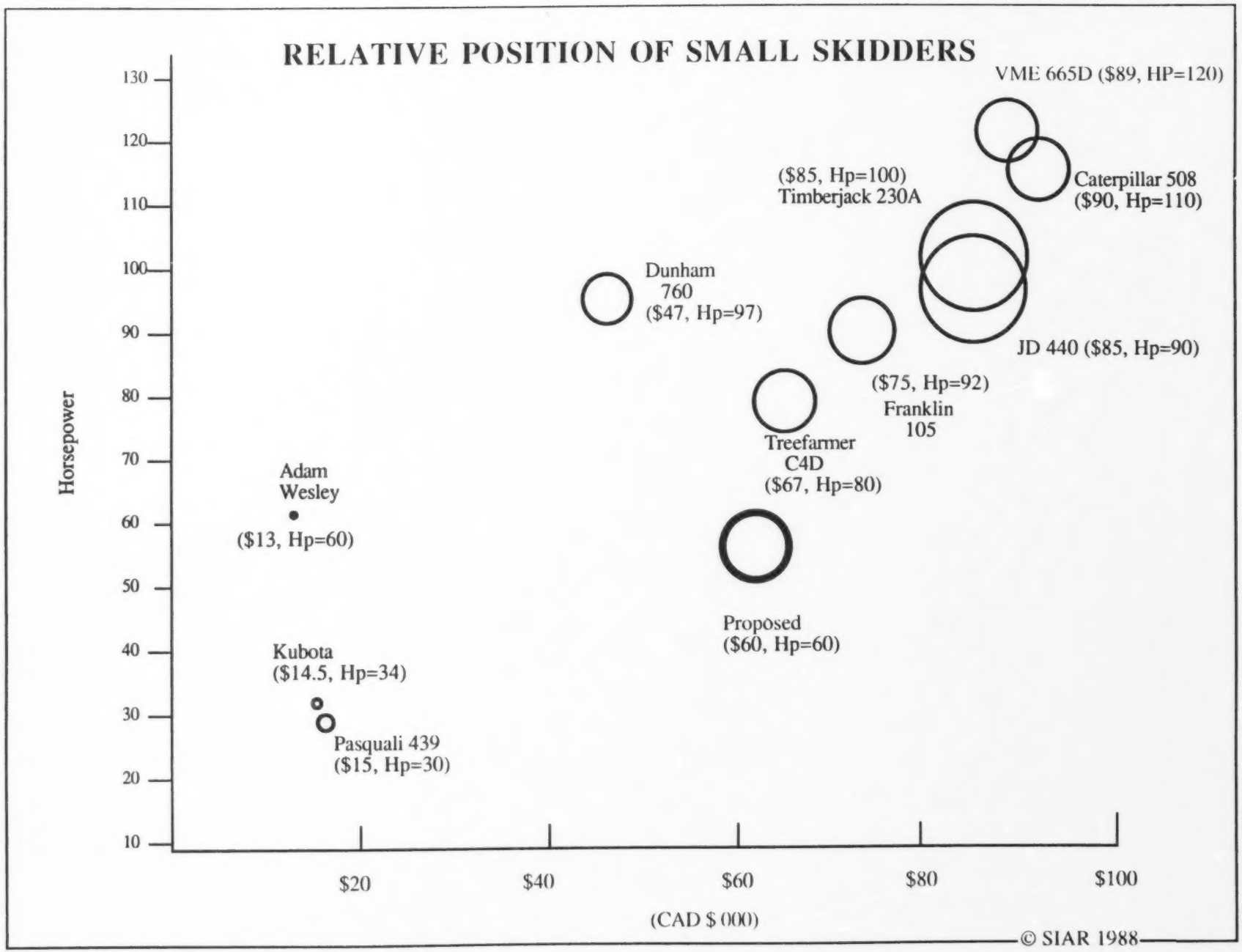
RELATIVE POSITION OF SMALL SKIDDERS
Horsepower
130
120
110
100
90
80
70
60
50
40
30
20
10
VME 665D ($89, HP=120)
($85, Hp=100)
Timberjack 230A
Caterpillar 508
($90, Hp=110)
Dunham
760
($47, Hp=97)
JD 440 ($85, Hp=90)
($75, Hp=92)
Franklin
105
Treefarmer
C4D
($67, Hp=80)
Adam
Wesley
($13, Hp=60)
Proposed
($60, Hp=60)
Kubota
($14.5, Hp=34)
Pasquali 439
($15, Hp=30)
$20
$40
$60
$80
$100
(CAD $ 000)
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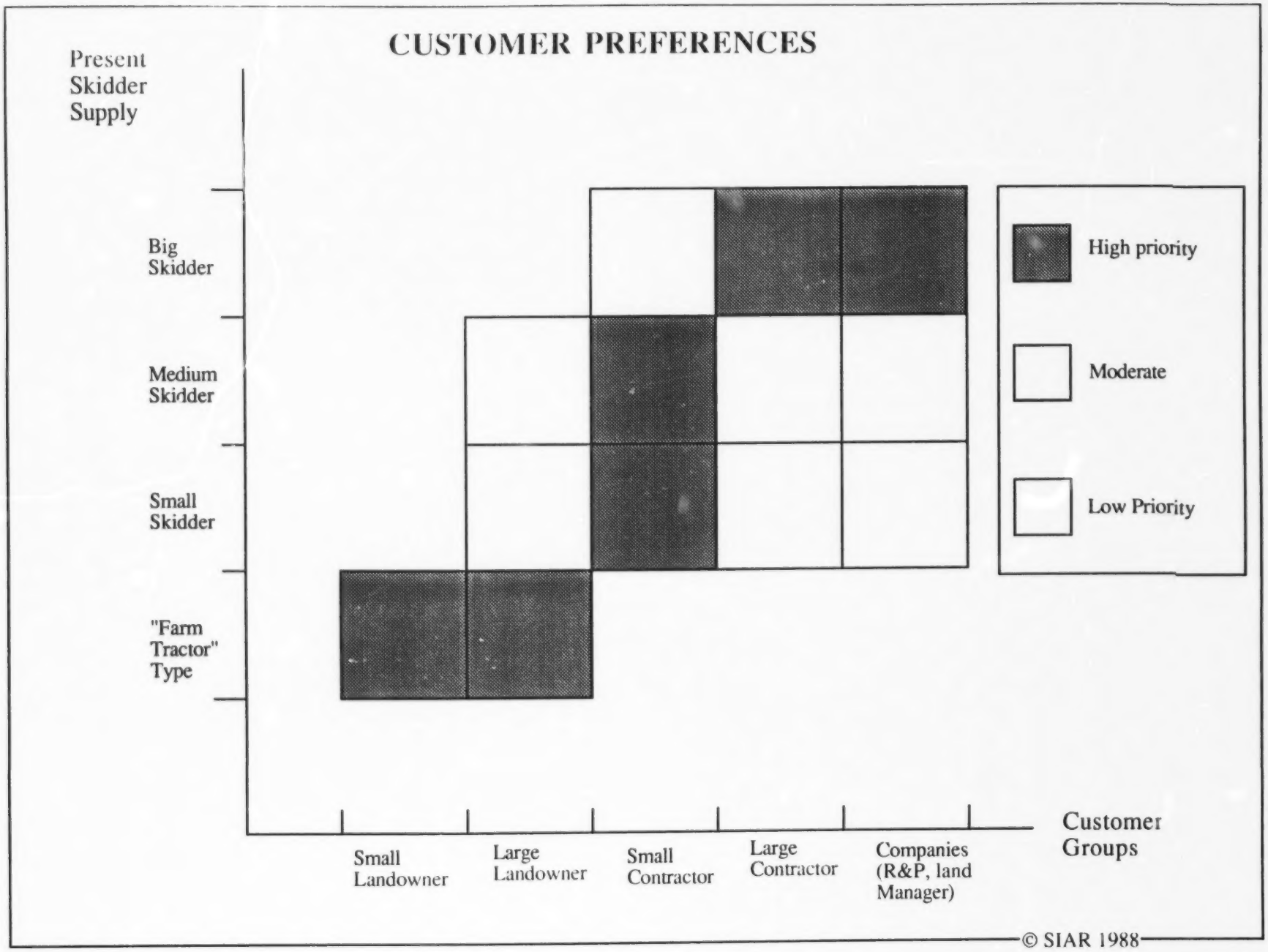
CUSTOMER PREFERENCES
Present Skidder Supply
Big Skidder
Medium Skidder
Small Skidder
"Farm Tractor" Type
High priority
Moderate
Low Priority
Small Landowner
Large Landowner
Small Contractor
Large Contractor
Companies (R&P, land Manager)
Customer Groups
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Appendix 16

KEY FACTORS FOR A SUCCESSFUL MARKET ENTRY

- Price
- Very Strong Dealer Network
- High After Sale Service Availability
- High Spare Parts Availability
- Financial Assistance

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